SPECIFICATION

TITLE OF THE INVENTION

DATA DISTRIBUTION SERVER AND TERMINAL APPARATUS

FIELD OF THE INVENTION

This invention relates to an apparatus for switching a bit rate of a distributed image in response to a result of monitoring of a received state at a mobile terminal and a method for switching it in an image distribution system in which a streaming is carried out for the coded image data from the distribution server toward the mobile terminal through a ratio circuit.

BACKGROUND OF THE INVENTION

In recent years, a rapid development of a broadband technology and a propagation of a mobile terminal such as a mobile phone or PDA (Personal Digital Assistance) or the like have expanded an image streaming service under an application of radio-infra structures such as a cellular phone communication network or radio LAN (Local Area Network) and the like. A problem found in the image streaming service under application of the radio network consists in a variation of the electromagnetic wave receiving state. As the receiving state is varied, the error in receiving operation frequently occurs, resulting in that

a re-transmission amount of data is increased. Due to this influence, there may occur a case in which the transferring rate of the streaming data is varied and a reproducing of image cannot be executed accurately. In particular, it becomes a serious problem how to accommodate for case in which a state having a superior receiving state is switched toward its deteriorating state.

The prior art for a controlling method responding to the electromagnetic wave receiving state in the image distribution system, provides a method in which the receiving terminal monitors the electromagnetic wave receiving state under a predetermined time interval in an electronic mail system and then a transmission order of the mails distributed by the distribution server is changed in response to the situation of change (for example, refer to the Patent Document 1).

In addition, as the transmission method performed through the moving image transmission device, there is also provided a method in which the receiving terminal always informs information indicating the receiving state to the distribution server to execute a controlling over the data communication speed at the distribution server (for example, refer to the Patent Document 2).

Further, there is also provided a method for executing a controlling over the data communication speed in which a

data communication speed is estimated at a mobile receiving terminal in reference to the electromagnetic wave receiving state and the content of the distributed image (sports and news or the like) and the result of estimation is informed to the distribution server (for example, refer to the Patent Document 3).

[Patent Document 1] JP-A No. 349808/2000

[Patent Document 2] JP-A No. 69483/2001

[Patent Document 3] JP-A No. 344560/2000

SUMMARY OF THE INVENTION

The methods in the Patent Documents 1 and 3 of the prior art described above are carried out such that the received state is monitored through observation of intensity of electromagnetic wave at the receiving terminal. However, in the case that many receiving terminals are concentrated at a certain one base center and the like, there occurs sometimes that a relation between the intensity of electromagnetic wave and the data communication speed is not necessarily proportionate to each other. Thus, in the case of this method, it is not possible to attain a complete holding of the received state at the terminal unit.

The method described in the Patent Document 2 is carried out such that the receiving terminal unit always

continues to transmit information concerning the received state against the distribution server in order to cause the distribution server to judge the received state at the receiving terminal unit. Due to this fact, the receiving terminal unit must always execute both transmission and receiving at the time of image streaming operation, resulting in that this method produces a problem that a line available efficiency is reduced and at the same time a processing load at the receiving terminal unit is increased.

This invention is provided to solve the aforesaid problem and it is an object of this invention to provide means having a function for causing the receiving terminal itself to monitor accurately the receiving bit rate at the time of image streaming operation and capable of executing a stable image streaming by requesting the distribution server to switch the receiving bit rate to the most-suitable image bit rate in response to the result of monitoring operation.

The distribution server in an image distribution system using a radio infra-structure has means for multiplexing information indicating an image data transmission start time in the image data to be distributed, and means for switching the image bit rate in response to a request from the receiving terminal. In addition, the receiving terminal unit is provided with means for

monitoring the receiving bit rate through utilization of information indicating the image data transmission start time and for informing a transmission request for the most suitable image bit rate to the distribution server in response to a result of monitoring.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a configuration of a receiving terminal unit;

Fig. 2 shows a configuration of a distribution server;

Fig. 3 shows a configuration of an image data;

Fig. 4 shows a structure of "uuid";

Fig. 5 shows a concept of generating "uuid" storing a monitoring trigger information;

Fig. 6 is a time chart of a receiving bit rate monitoring;

Fig. 7 shows a relation between a data transferring time in an image data distribution and a bit rate;

Fig. 8 shows one example of an image bit rate table;

Fig. 9 shows one example of an image bit rate switching point table;

Fig. 10 shows a form of use of an image bit rate table and an image bit rate switching point table;

Fig. 11 shows one example of an image bit rate switching operation for an upper level mode;

Fig. 12 shows one example of an image bit rate switching operation for an upper level mode;

Fig. 13 shows another example of an image bit rate switching operation for an upper level mode;

Fig. 14 shows another example of an image bit rate switching operation for a lower level mode;

Fig. 15 is a flow chart for showing an operation of a distribution server;

Fig. 16 is a flow chart for showing a processing of multiplexing "uuid" storing the monitoring trigger information to the distribution image data;

Fig. 17 is a flow chart for showing an entire operation of a receiving terminal unit;

Fig. 18 is a flow chart for showing a receiving bit rate controlling procedure;

Fig. 19 is a flow chart for showing a receiving bit rate controlling procedure using an ascending switching sensitivity and a descending switching sensitivity;

Fig. 20 is a flow chart for showing a procedure for measuring the receiving bit rate;

Fig. 21 shows one example of a practical form using a distribution server and a receiving terminal;

Fig. 22 shows an example of a typical practical form using a distribution server and a receiving terminal unit; and

Fig. 23 shows one example of a user-interface of the receiving terminal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, some preferred embodiments of an image distribution apparatus and an image receiving method in accordance with the present invention will be described as follows.

Fig. 1 shows a configuration of a receiving terminal unit 100 of the present invention.

Image data received by the receiving terminal unit 100 is a data compressed by a predetermined coding system such as MPEG or the like and the image data is distributed from a distribution server 200 to the receiving terminal 100 through a radio communication network 112 and a relay center 113.

The radio communication unit 101 transmits and receives data through radio communication with a distribution server 200. An image data receiving unit 102 receives data transmitted from the distribution server 200. The received image data is stored in a memory unit 104 through an analysis unit 103. The analysis unit 103 performs an extraction to extract monitoring trigger information included in the image data and inform it to a monitoring trigger control unit 109 and informing of a data size of the

image data to a receiving bit rate monitoring unit 110. The monitoring trigger information is meant by information indicating a time in which the receiving bit rate-monitoring unit 110 starts a monitoring operation, or information becoming a trigger in which the receiving bit rate-monitoring unit starts a monitoring operation. The memory unit 104 is used for temporarily storing the image data. A reproducing unit 105 reads out the image data in sequence from the memory unit 104 in sequence to perform an expansion processing, the moving image after expansion is displayed at a monitor 106 and its audio signal is outputted at a speaker 107. Further, in the case that the received image data is enciphered, the reproducing unit 105 is provided with a decoder to perform a decoding operation. It is of course apparent that when the image data is not enciphered, this decoder is not essentially needed. A reference timer 108 is a timer becoming a reference for a synchronous reproduction for both moving image and audio. In addition, the reference timer 108 is also used for a comparison at the monitoring trigger control unit 109 with a time included in the monitoring trigger information. The monitoring trigger control unit 109 compares a time at the reference timer 108 with a time indicated in the monitoring trigger information, and when they are coincided to each other, this monitoring trigger control unit 109 applies a

trigger for starting the monitoring operation against the receiving bit rate-monitoring unit 110. The receiving bit rate-monitoring unit 110 performs a monitoring operation against the received bit rate from a time in which the trigger is applied from the monitoring trigger control unit 109. In the case that a result of monitoring is displaced out of a predetermined bit rate range, a command transmission unit 111 requests an image data bit rate switching against the distribution server 200. When the result of monitoring operation is in a predetermined bit rate range, it does not request a bit rate switching against the distribution server 200. The command transmission unit transmits commands of a distribution starting of image data, a distribution stopping of image data and an image bit rate switching request and the like against the distribution server 200.

Fig. 2 shows a configuration of the distribution server 200 of the present invention.

Image data transmitted through an external public network 210 such as an internet or the like is received at the image data input unit 201 and stored at the memory unit 202. The reference timer 206 generates reproducing time information applied at the time of reproduction of the image data at the receiving terminal unit 100 and transmits it to the image data re-construction unit 203. A monitoring

trigger information generating unit 207 refers to the time information of the reference timer 206, generates monitoring trigger information used by the receiving bit rate monitoring unit 110 of the receiving terminal unit 100 and transmits it to the image data re-construction unit 203. The image data re-construction unit 203 multiplexes the reproduced time information got from the reference timer 206 and the monitoring trigger information got from the monitoring trigger information-generating unit 207 on the image data read out of the memory unit 202. The image data transmission unit 204 transmits the multiplexed image data to the receiving terminal 100. As also shown in Fig. 1, the image data transmitted from the distribution server 200 is transmitted to the receiving terminal 100 through the radio communication network 112 and the relay center 113. The radio communication unit 205 performs a transmission and a receiving of data with the receiving terminal 100 through radio communication. The command receiving unit 208 receives some commands such as a distribution starting, a distribution stopping and an image bit rate switching request and the like sent from the receiving terminal 100. The bit rate switching control unit 209 performs a switching from the image bit rate during the present distribution operation to an image bit rate indicated in the command when the bit rate switching control unit 209 receives the image

bit rate switching request command from the receiving terminal 100.

Fig. 3 shows a structure of the image data.

A certain one image data has a structure in which a plurality of fragments 300 are in a continuous form. The fragments 300 are meant by a certain collected data unit in which the image data is divided by every predetermined reproduction time length and control information required for reproduction is added to each of the image data. A time length applied as a reference of dividing operation can be optionally set and it may also be applicable that each of them has a different length to each other.

Fig. 3A shows a structure of one fragment 300. The fragment 300 is constituted by a row of telop characters optionally displayed in multiplex form on the reproduced image or the like, "uuid" (Universal Unique Identifier) (301) having additional information stored in it that a user can optionally define, a header 302 having information required for reproduction such as random access control information and the like, moving image of predetermined reproduction time length and an audio data 303. In the case of example illustrated in this figure, although one "uuid" is left in the fragment, it may also be applicable that a plurality of "uuid"s are prepared in response to the number of user defined information. In the case of the image

distribution method of the present invention, monitoring trigger information is stored in one of the "uuid"s. The monitoring trigger information is used as a trigger for starting a measurement of the received bit rate. Data transfer of one fragment is a burst transfer (its details will be described in reference to Fig. 7). The receiving terminal 100 can know accurately a burst transfer starting time in reference to the monitoring trigger information to cause a measurement accuracy of the receiving bit rate to be improved. The monitoring trigger information is information regarding a transmission and receiving of the image data and this information has not direct relation with the reproduction of image. Accordingly, it is desirable to insert it into "uuid" aiming at storing optional information concerning the reproduction of image. In addition, "uuid" is operated through utilization of ID assured that it is not overlapped in the system. The system not requiring any monitoring trigger information enables the monitoring trigger information to be ignored through discrimination of ID and it has also an effect to prevent any unintentional erroneous operation. It is of course apparent that it can be inserted into the header other than "uuid".

Fig. 3(B) shows a structure having a plurality of fragments 300 connected to each other. An arrangement of the fragment 300 of the image data becomes a structure in

which the fragments are arranged from the leading one in an order of reproducing time. In the case of the example shown in this figure, the fragment (304) is reproduced at first and then the fragment$_{n+1}$ (305) is reproduced. As shown in Fig. 3(A), the "uuid" (301), the header (302) and the moving image and audio data (303) constitute each of the fragments.

Fig. 4 shows a structure of "uuid" (301).

The "uuid" is a data that a user optionally can define, and the moving image and the audio data are separately added to the image data. As shown in Fig. 4(A), the "uuid" (301) is constituted by a size of the entire "uuid", a row of text characters (402) expressing "uuid", an identification ID (403) and a data unit (404). In the case that the monitoring trigger information is stored in the "uuid" (301), the trigger time information instructing a starting of the received bit rate monitoring operation at the receiving terminal 100 is stored at the data unit (404). Fig. 4(B) shows one example of the "uuid" (301) storing the monitoring trigger information. Fig. 4(B) shows one example of the "uuid" (301) having the monitoring trigger information stored in it. In the example shown in Fig. 4(B) is indicated that the "uuid" size 405 has 28 bytes. The row of text characters (406) expressing the "uuid" is common irrespective the type of "uuid" and the processing unit recognizes that this data is "uuid" through the row of text

characters. The identification ID (407) is a code for use in recognizing the type of "uuid". In the case of row shown in this figure, the identification ID (407) is a code indicating that the row of characters expressing "TRIGTIME-0000000" is a monitoring trigger information, and the receiving terminal 100 detects the row of characters and recognizes the monitoring trigger information. "123456msec" stored at the final data is information expressing a trigger time at the receiving terminal 100.

Fig. 5 shows a concept for generating "uuid" storing the monitoring trigger information at the distribution server 200.

In this figure, "uuid" storing the monitoring trigger information is indicated as TRIGuuid. TRIGuuid (502) of a fragment_n (505) distributed at a distribution time T0 (508) stores a planned time T1 (509) in which a next fragment_{n+1} (506) is distributed. Similarly, TRIGuuid (503) of a fragment_{n+1} (506) distributed at a distribution time T1 (509) stores a planned time T2 (510) in which a fragment_{n+2} (507) is distributed, and TRIGuuid (504) of a fragment_{n+2} (507) distributed at a distribution time T2 (510) stores a planned time T3 (511) in which a subsequent fragment is distributed. In this way, TRIGuuid of the fragment at a certain

distribution time stores without fail a distribution planned time for fragment distributed next.

As another preferred embodiment, it is also applicable that TRIGuuid stores a distribution-planned time for either a header part or a moving image/audio data in the same fragment. In this case, although TRIGuuid is out of a target of a receiving bit rate measurement, this does not become a substantial problem because a data size of TRIGuuid is quite small as compared with that of its subsequent moving image/audio data.

As a further preferred embodiment, in the case that the distribution server 200 and the receiving terminal 100 store a transmitter of the same clock, it may also be applicable that TRIGuuid stores a clock counter value to be distributed in place of time information. The clock counter value may be a calculated clock value from the starting time or a relative clock value from a previous fragment distribution.

Fig. 6 shows a time-chart for a receiving bit rate monitoring at the receiving terminal 100.

Since data transfer of one fragment is carried out in a burst transfer, the data transfer is completed in a shorter time than an image data reproducing time of that fragment. The receiving bit rate at the receiving terminal 100 is calculated through measurement of a time of this burst

transfer segment and a received data size. For example, a processing at the time of receiving of fragment at the receiving terminal 100 is carried out as shown in Fig. 6. At first, a fragment 1 (614) is received (600) at a time T0 (610) and then TRIGuuid having the monitoring trigger information stored is analyzed (601) at the analysis unit (103). This TRIGuuid stores a receiving time T1 (611) of a next fragment 2. A monitoring trigger control unit 109 at the receiving terminal 100 performs a time comparing processing (602) with the reference timer 108 for a receiving time T1 (611). The distribution server 200 starts a distribution of the fragment 2 (615) from a reaching time of T1 (611). The receiving terminal 100 performs a data receiving operation (605) of the fragment 2 (615) from a time T1 (611) and concurrently starts a measurement of receiving bit rate at (603). In addition, the header of the fragment 2 (605) stores a data size of the fragment. This data size is read out and used for detection of a completion of the data receiving for the fragment 2 and a completion of measurement of the receiving bit rate. Also at the time of data receiving of the fragment 2 (615) and the fragment 3 (616) after this operation, the processing is carried out in the order of the data receiving of fragment (605), TRIGuuid analysis (606), a timer operation of monitoring

trigger (607), a receiving bit rate measurement (608) and a fragment size analysis (609).

Fig. 7 shows a relation between a typical data transfer time and a bit rate at an image data distribution.

As already been described in reference to Fig. 6, since the data transfer for one fragment is a burst transfer, the data transfer is completed in a shorter time than an image data reproducing time for that fragment. The time for the data transfer is determined in reference to a transfer frequency of a radio line. Upon receiving of the image data fragment having an image bit rate CBR (706) and an image reproducing time Fts1 second (707) at the receiving terminal 100, the data is received at a faster receiving bit rate RBR (705) than the image bit rate CBR (706), so that a receiving of data is completed in a shorter Bts1 sec. than an image reproducing time Fts1 sec. (707). If it is assumed that a size of each of the fragments (701, 702, 703) and the receiving bit rate RBR (705) are kept constant, fragment-receiving times (710, 711, 712) are also kept constant. However, actually, since the fragment size and the receiving bit rate are changed for every fragment, the fragment receiving time does not become a constant value as shown in Fig. 7.

Fig. 8 shows one example of an image bit rate table 800.

An image bit rate table 800 is a table indicating the type of the image bit rate CBR (706) that the distribution server 200 can deliver. Both the distribution server 200 and the receiving terminal 100 use this table.

In the example illustrated in the figure, this shows that it is possible to deliver three kinds of image bit rates of 100 kbps, 200 kbps and 300 kbps. The number of image bit rates can be optionally set and the value of bit rate can also be optionally set. In order to identify the type of image bit rate CBR (706), the mode 801 is used. In this figure, the mode 0 (802) is 100 kbps, the mode 1 (803) is 200 kbps and the mode 2 (804) is 300 kbps.

In the case that a plurality of bit rates are to be prepared for the same image, the amount of data to be distributed is changed and the bit rate is changed by changing image quality of image, quality of audio, image size and the displayed number of image per specified unit of the image and the like. The receiving bit rate-monitoring unit 110 at the receiving terminal 100 refers to the image bit rate table 800. This table may store a predetermined exclusive memory at the receiving terminal 100 and is stored at a part of the memory unit 104. Additionally, the bit rate switching control unit 209 refers at the distribution server 200. This table may be stored in a predetermined exclusive

memory in the same manner as that for the receiving terminal 100 and may be stored at a part of the memory unit 202.

Fig. 9 is a diagram for showing one example of an image bit rate switching point table 900.

The image bit rate switching point table 900 is a table used for performing a comparison with a received bit rate measured by the receiving bit rate-monitoring unit 110 of the receiving terminal 100 and referred to judge whether or not it is switched to another bit rate against the distribution server. The receiving terminal 100 uses this table and this is constituted by information of the upper limit bit rate UBR (901) and information of lower limit bit rate BBR (902) for every mode 903 of the image bit rate. The type of mode 903 is set such that it may be coincided with the image bit rate table 800. The upper limit bit rate UBR (901) and the lower limit bit rate BBR (902) are set in response to a relation of performance between a fragment size distributed by the distribution server 200 and a transfer frequency of the radio line to be used. In the example shown in this figure, this shows that no image bit rate switching is carried out if the receiving bit rate is between 1.8 Mbps and 2.2 Mbps during receiving of the mode 1 (905). In the case that the value is lower than 1.8 Mbps, it is switched over to the mode 0 (904) and in turn when the value exceeds 2.2 Mbps, it is switched over to the mode 2

(906). If the receiving bit rate does not exceed 1.2 Mbps during a state in which the mode 0 (904) is being received, this expresses that an image bit rate switching is not performed. If the rate exceeds 1.2 Mbps, it is switched to the mode 1 (905). In the example shown, the lower limit bit rate BBR 8902) is not set because the image bit rate less than the mode 0 (904) is not present. If the receiving bit rate does not lower 2.8 Mbps during a state in which the mode 2 (906) is being received, this expresses that an image bit rate switching is not performed. If the value lowers 2.8 Mbps, the mode is switched to mode 1 (905). In the example shown in this figure, the upper limit bit rate UBR (901) is not set because the image bit rate more than mode 2 (906) is not present. It is satisfactory to record information specifying a bit rate corresponding to each of the modes other than the specified value shown in Fig. 9.

The receiving bit rate monitoring unit 110 at the receiving terminal 100 refers to the image bit rate switching point table 900. The table may be stored in a predetermined exclusive memory at the receiving terminal 100 or may be stored partially at the memory unit 104.

Fig. 10 shows a form of use of the image bit rate table 800 and the image bit rate switching point table 900.

Both the distribution server 200 and the receiving terminal 100 use the image bit rate table 800. The receiving

terminal 1 (1001) and the receiving terminal 2 (1002) kept in a connected relation with a certain distribution server 1000 have tables (1008, 1010) having the same content as that of the image bit rate table 1005 owned by the distribution server 1000. As another embodiment, it may also be applicable that the receiving terminal 100 performs a direct transmission of data indicating the image bit rate value as a method for specifying the image bit rate to the distribution server 200, and the distribution server reconstructs the image data in response to the specified image data. In this case, it may also be applicable that the distribution server 200 does not use the image bit rate table 800. The receiving terminal 100 uses the image bit rate switching point table 900. It is necessary that the content in the table is prepared for every radio network so as to be dependent on a transfer frequency at the radio line. For example, the image bit rate switching point table 1009 at the receiving terminal (1001) connected to the radio network 1 (1003) and the image bit rate switching point table 1011 at the receiving terminal (1002) connected to the radio network 2 (1004) have different set contents for every mode.

These two tables may also be set in advance at the distribution server 1000, the receiving terminal 1 (1001) and the receiving terminal 2 (1002). In addition, it may also be applicable that the table corresponding to the radio

network to be relayed is transmitted from the distribution server 1000 to the receiving terminals 1001, 1002 before starting distribution of the image data because the receiving terminal moves on a different radio network. In the case of the radio network having a different data transfer performance, if the operation is applied without switching the table, it might become a cause for inducing an erroneous operation because the image bit rate switching point is different due to a difference of transferring capability. Accordingly, if the table is tried to be transmitted at the time of starting of streaming and at the time of switching of the radio network, it might be possible to prevent the image bit rate switching from being erroneously performed.

In this way, even if the receiving terminal 100 moves on the radio network having a different data transferring performance, the image bit rate switching can be applied through utilization of the most-suitable table to each of the radio lines.

Fig. 11 shows one example of the image bit rate switching operation to an upper level mode.

It is assumed that the receiving terminal 100 uses the image bit rate table 800 and the image bit rate switching point table 900 shown in Figs. 8 and 9 and the receiving terminal 100 receives the image data of mode 1. A range of

the receiving bit rate RBR (1104) for maintaining the image bit rate under the mode 1 is 1.8 Mbps to 2.2 Mbps. The image bit rate switching is not carried out because the receiving bit rate RBR (1104) at the receiving 1 (1100) and the receiving 2 (1101) is 2.0 Mbps. The image bit rate switching 1105 from the mode 1 to the mode 2 is requested against the distribution server 200 because the receiving bit rate RBR (1104) exceeds 2.2 Mbps at the time of receiving 3 (1102). With this operation, the server switches the bit rate, and the terminal receives the image data of the mode 2 from the receiving 4 (1103).

As already been described in reference to Fig. 8, differences in image caused by a difference of the image bit rates before and after the mode switching operation are image quality, quality of audio, image size and the number of displays per predetermined unit of image and the like.

Fig. 12 shows one example of an image bit rate switching operation to a lower level mode.

It is assumed that the receiving terminal 100 is receiving an image data of mode 1 under application of the image bit rate table 800 and the image bit rate switching point table 900 shown in Figs. 8 and 9 in the same manner as that shown in Fig. 11. The image bit rate switching is not carried out because the receiving bit rate RBR (1204) of the receiving 1 (1200) and the receiving 2 (1201) is 2.0

Mbps. The image bit rate switching 1205 is requested against the distribution server 200 from the mode 1 to the mode 0 because the receiving bit rate RBR (1204) lowers 1.8 Mbps at the time of receiving 3 (1202). Thus, the image data of mode 0 is received from the receiving 4 (1203).

Fig. 13 shows another example of an image bit rate switching operation to an upper level mode

In the case that the receiving bit rate is rapidly changed in a continuous manner, the image bit rate switching is frequently produced and becomes a load for the image data distribution. In this case, it may also be applicable that a controlling operation is carried out in such a manner that a unit for discriminating an image bit rate switching has certain sensitivity and the number of occurrence of switching is reduced.

This figure shows an example in which an ascending switching sensitivity uc-sensi (1307) is set in the case of switching to the upper level mode. The ascending switching sensitivity uc-sensi (1307) is a numerical value indicating that the image bit rate switching is requested at how many times it exceeds the receiving bit rate RBR (1305) in a continuous manner. For example, it is assumed that the ascending switching sensitivity uc-sensi (1307) is set to 3 and the image data of mode 1 is being received. At the time of receiving 1 (1300), the image bit rate switching is

not carried out because the receiving bit rate RBR (1305) is 2.0 Mbps. However, the image bit rate switching 1306 from the mode 1 to the mode 2 is requested against the distribution server 200 because the receiving bit rate RBR (1305) exceeds 2.0 Mbps by three times in a continuous manner at the receiving 2 (1301), receiving 3 (1302) and receiving 4 (1303). The image data of mode 2 is received from the receiving 5 (1304). The ascending switching sensitivity uc-sensi (1307) is held by the receiving bit rate monitoring unit 110 of the receiving terminal 100. The maximum value of the ascending switching sensitivity uc-sensi (1307) is dependent on an accumulated capacity of the image data at the memory unit 104. It is at least necessary that the same image data of fragment as that of the number of times avoiding the image bit rate switching (i.e. a value of switching sensitivity) is always stored in the memory unit 104 prior to the reproduction. It is possible that the ascending switching sensitivity uc-sensi (1307) can be automatically set by the receiving terminal 100 through calculation of a capacity of the memory unit 104 and a mean value of data size of one fragment attained in response to the image bit rate. In addition, a user may also set it optionally.

Fig. 14 shows another example of an image bit rate switching operation to a lower level mode.

The image bit rate switching method used the ascending switching sensitivity shown in Fig. 13 may also be applicable to an image bit rate switching operation to a lower level. In this figure, it is assumed that the descending switching sensitivity dc-sensi (1407) is set 3 and the image data of mode 1 is being received. The image bit rate switching is not carried out at the time of receiving 1 (1400) because the receiving bit rate RBR (1405) is 2.0 Mbps. An image bit rate switching 1406 from mode 1 to mode 0 is requested against the distribution server 200 because the receiving bit rate RBR (1405) lowers 1.8 Mbps continuously by three times at the receiving 2 (1401), receiving 3 (1402) and receiving 4 (1403), respectively. The image data of mode 0 is received from the receiving 5 (1404).

The descending switching sensitivity dc-sensi (1407) is held at the receiving bit rate monitoring unit 110 of the receiving terminal 100. In addition, a method for setting the descending switching sensitivity dc-sensi (1407) is also similarly carried out in the same manner as that for the ascending switching sensitivity uc-sensi (1307).

Fig. 15 is a flow chart for showing an operation of the distribution server 200.

At first, it is discriminated whether or not an operation of the distribution server 200 is stopped (1500).

In the case of continuing the operation, it is discriminated at (1501) whether or not there is provided a command receiving operation from the receiving terminal 100. In the case of stopping operation, it is discriminated at (1512) whether or not the image data is being distributed at present, and if the distribution is being carried out, the distribution is stopped at (1513) and the processing is finished. In the case that a receiving of command is present during continuation of operation, the command is analyzed at (1502) and it is discriminated at (1503) whether or not it is a request for starting distribution with the image bit rate CBR. If this is a request for starting distribution, it is discriminated at (1504) whether or not the image data has already been distributed. If the image data has already been distributed, it is discriminated at (1505) whether or not the image bit rate being distributed is the same as the requested image bit rate CBR. In the case that the image bit rate CBR is the same as the image bit rate being distributed, the command is ignored. In the case that they are different from each other, it is switched to the image bit rate CBR requested by the command and the distribution is started (1506). If the command is not a request for starting distribution at the processing 1503, subsequently it is discriminated at (1508) whether or not the command is a request for stopping distribution. If the command is a

request for stopping distribution, it is discriminated at (1509) whether or not the operation has already been stopped and in turn if the operation is not stopped, distribution of image data is stopped at (1510). In the case that the operation has already been stopped, the command is ignored. In the case that the command is not a request for stopping distribution at the processing 1508, an error processing is carried out at (1511) because the command cannot be recognized by the distribution server 200. As an example of the error processing, there is present a processing or the like to inform the receiving terminal that the command is not effective. It may also be applicable as a method in which the distribution server 200 switches the image bit rate that a plurality of kinds of image data indicated in the image bit rate table 800 are all prepared in advance in an image data inputted from outside and the image data with the image bit rate specified by the receiving terminal 100 is selected out of them and distributed. In addition, in the case that the image data that the distribution server 200 inputs from outside is one non-compressed image data, an image data converted by a predetermined method may also be distributed by changing some parameters such as the number of frames to be transmitted, for example, in such a manner that the image data shows an image bit rate specified by the receiving terminal 100. Further, in the case that

the image data inputted by the distribution server 200 from outside is one compressed image data, the image data re-converted by a predetermined method may also be distributed in such a manner that the bit rate may become an image bit rate specified by the receiving terminal 100.

Fig. 16 is a flow-chart for indicating that the distribution server 200 performs a multiplexing processing against "uuid" having the monitoring trigger information stored in the distribution image data.

At first, the image data is inputted from outside through the image data input unit 201 (1600). Next, the fragment of the image bit rate GBR is extracted from the inputted image data through an image data re-construction unit 203 (1601). Concurrently, a next fragment transmission starting time is set at "uuid" through a monitoring trigger information generating unit 207 (1602). In the case that the fragment is constituted every certain specified time, a reference timer 206 is referred to and one fragment time is added from the transmission time of the fragment to be transmitted now to set a transmission starting time. In the case that the fragment time interval is not constant, a reproducing time for the fragment to be transmitted now is added to a transmission time of the fragment to be transmitted to set a transmission start time. The transmission start time is distributed to the receiving

terminal 100 through the image data transmission unit 204 by multiplexing "uuid" to the extracted fragment through the image data re-constructing unit 203 (1604).

Fig. 17 is a flow chart for showing an entire operation of the receiving terminal 100.

At first, a streaming of the image data is started (1700) to set the reference timer (1701). During the streaming operation, the receiving bit rate control is executed through the receiving bit rate monitoring unit 110 (1702) in parallel with the receiving (1700) of the image data through the image data receiving unit 102 and a reproducing operation (1704) through a reproducing unit 105. This operation is repeated until the streaming operation is completed (1705).

Fig. 18 is a flow chart for showing an order of the receiving bit rate controlling operation at the receiving terminal 100.

At first, a $mode_n$ of the required image data is set at the distribution server 200 (1800). The image bit rate GBR is determined from the $mode_n$ in reference to the image bit rate table 800. Next, the upper limit rate UBR and the lower limit bit rate BBR are got (1801) in reference to the image bit rate switching point table 900, and a distribution starting request command with the image bit rate CGR is transmitted to the distribution server 200 (1802).

Subsequently, it is discriminated whether or not the streaming operation is finished (1803) and if the operation is to be finished, the distribution stopping request command is transmitted to the distribution server to finish the processing (1814). In the case that the streaming operation is to be continued, the receiving bit rate RBR is measured (1804) to compare the upper limit bit rate UBR with the lower limit bit rate BBR (1805, 1806). If the receiving bit rate RBR is in a range between the upper limit bit rate UBR and the lower limit bit rate BBR, the present mode is kept (1807). In the case that the mode is kept, a request command transmission is not carried out against the distribution server 200. Also in the case that the distribution server keeps the present mode in order to hold a recording of the received state of the receiving terminal 100, it may also be applicable that its gist is informed to the distribution server 200. In the case that the receiving bit rate RBR exceeds the upper limit bit rate UBR at the processing 1805, it is discriminated at (1808) whether or not the mode of the higher image bit rate than that of the present one can be specified. If the mode can be specified, the mode higher than the present image bit rate CBR is set at the request command (1809) and transferred to the processing 1801 in order to transmit it to the distribution server 200. In the case that the mode cannot be specified, the error processing

is carried out (1810). An example of the error processing is to display a message at the monitor of the receiving terminal 100 that the image bit rate switching cannot be executed and the like. However, in this case, the error processing operation can be skipped because the receiving bit rate is in an ascending direction. In the case that the receiving bit rate RBR is lower than the lower limit bit rate BBR at the processing 1806, it is discriminated at (1811) whether or not the mode of the lower image bit rate than the present one can be specified. In the case that the mode can be specified, the lower mode than that of the present image bit rate CBR is set at the request command (1812), and it is transferred to the processing 1801 in order to transmit it to the distribution server 200. In the case that the mode cannot be specified, the error processing is carried out (1813). An example of the error processing is to display a message at the monitor of the receiving terminal 100 that the image bit rate switching cannot be executed and the like.

Fig. 19 is a flow-chart showing an order of receiving bit rate control under application of the ascending switching sensitivity and the descending switching sensitivity at the receiving terminal 100.

At first, a counter (uc) for storing a continuous ascending time of the receiving bit rate and a counter (dc) for storing a continuous descending time of the receiving

bit rate are reset to 0 (1901). Next, the ascending switching sensitivity uc-sinsi and the descending switching sensitivity dc-sinsi are set (1902). In the example in this figure, both sensitivities are set to 3. Subsequently, a $mode_n$ of the required image data is set at the distribution server 200 (1903). The image bit rate CBR is determined from the $mode_n$ in reference to the image bit rate table 800. Next, the image bit rate switching point table 900 is referred to and the upper limit bit rate UBR and the lower limit bit rate BBR are attained (1904), and the distribution starting request command of the image bit rate CBR is transmitted to the distribution server 200 (1905). Subsequently, it is discriminated at (1906) whether or not the streaming operation is finished, and in the case that the streaming operation is finished, the distribution stopping request command is transmitted to the distribution server to finish the processing (1825). In the case that the streaming operation is continued, the receiving bit rate RBR is measured (1907) to compare the upper limit bit rate UBR with the lower limit bit rate BBR (1908, 1909). If the receiving bit rate RBR is in a range between the upper limit bit rate UBR and the lower limit bit rate BBR, the present mode is maintained (1910). In the case that the receiving bit rate RBR at the processing 1908 exceeds the upper limit bit rate UBR, it is discriminated at (1911) whether or not the mode

of the higher image bit rate than the present one can be specified. In the case that the mode cannot be specified, the error processing is carried out (1916) and the continuous ascending time counter (uc) is rest to 0 (1917). An example of error processing is a displaying of a message at the monitor of the receiving terminal 100 saying that the image bit rate switching to the upper level mode cannot be executed. However, in this case, it may also be applicable that the error processing can be skipped because the receiving bit rate is in an ascending direction. In the case that the mode can be specified, it is discriminated at (1912) whether or not a result of comparison between the receiving bit rate RBR and the upper limit bit rate UBR is the same as the previous result of comparison. If the result of comparison is different, the continuous ascending time counter (uc) is reset to 0 (1917). If the result of comparison is the same, the continuous ascending time counter (uc) is added to 1 (1914) and it is discriminated at (1914) whether or not the ascending switching sensitivity uc-sinsi and the continuous ascending time counter (uc) are equal to each other. In the case that they are not equal to each other, the operation is transferred to the processing 1906 and returns to a normal processing loop. In the case that they are equal to each other, the higher mode than that of the present image bit rate CBR is set to a

request command (1915) and it is transferred to the processing 1904 to be transmitted to the distribution server 200. In the case that the receiving bit rate RBR is lower than the lower limit bit rate BBR at the processing 1909, it is discriminated at (1918) whether or not the mode of lower image bit rate than the present value can be specified. If the mode cannot be specified, the error processing is carried out (1923), and the continuous descending time counter (dc) is reset to 0 (1924). An example of the error processing displays a message at the monitor of the receiving terminal 100 saying that the image bit rate switching to the lower level mode cannot be executed. In the case that the mode can be specified, it is discriminated at (1919) whether or not a result of comparison between the receiving bit rate RBR and the upper limit bit rate BBR is the same as the previous result of comparison. If the result of comparison is different, the continuous descending time counter (dc) is reset to 0 (1924). If the result of comparison is the same, 1 is added to the continuous descending time counter (dc) (1920) and it is discriminated at (1921) whether or not the descending switching sensitivity dc-sinsi and the continuous descending time counter (dc) are equal to each other. In the case that they are not equal to each other, the operation is transferred to the processing 1906 and returns to a normal processing

loop. In the case that they are equal to each other, the lower mode than that of the present image bit rate CBR is set to a request command (1922) and it is transferred to the processing 1904 to be transmitted to the distribution server 200.

Fig. 20 is a flow-chart indicating a procedure for measuring the receiving bit rate at the receiving terminal 100.

At first, the monitoring trigger time is read out of the received fragment "uuid" (2000) and set to the monitoring trigger control unit 109 (2001). In the example shown in the figure, the monitoring trigger time is defined as TRGT. The reference timer time is compared with the monitoring trigger time TRGT and it is waited until they are coincided to each other (2002). When they are coincided to each other, the reference timer time TS at this time is read out (2003). A receiving of new fragment is started from the time TRGT. At this time, a fragment size FSIZE is read out (2004) of the header of the fragment. Subsequently, a data size of the fragment being received is counted (2005) and this is repeated until the counted value reaches FSIZE (2006). When the counted value reaches FSIZE and the receiving of the fragment is completed, the reference timer time TE at that time is read out (2007). Lastly, the receiving bit rate RBR is calculated (2008). The receiving

bit rate RBR is a value in which the fragment size FSIZE is divided by the time (TE-TS) required for receiving operation. The method shown in Fig. 20 can hold only a period in which the data being burst transferred is reached at the receiving terminal 100. Thus, a measurement accuracy of the receiving bit rate can be improved and an accurate image bit rate switching control can be performed because no measurement is carried out also at a time other than the burst transferring period where the data is not reached as compared with a technology for measuring a predetermined time, for example.

A method for monitoring the received state for use in requesting an image bit rate switching at the receiving terminal 100 is not limited to the aforesaid method, but may be carried out by another method. For example, as already been described in the description on Fig. 5, either the header unit of the fragment or the re-distribution planned time for the data unit on the moving image and audio may be stored as the monitoring trigger information. Further, as a still further embodiment, in the case that the distribution server 200 and the receiving terminal 100 store a transmitter having the same clock, a clock counter value planned to be distributed may be stored as the monitoring trigger information in place of the time information. The clock counter value may be an accumulated clock value from

the starting time or a relative clock value from the previous fragment distributing operation.

Fig. 21 shows one example of an applied form in which the deliver server 200 of the present invention and the receiving terminal 100 are applied.

This figure shows an example of configuration in which to the distribution server 2100 are connected a TV receiver set 2101 for receiving a TV broadcasting, an external public network 2103 such as an internet or the like, an image memory device 2102 for use in recording image data inputted from the external public network 2103 and image data having a TV program received by the TV receiver set 2101 converted by a predetermined converting method, a transmitter center A (2103) and a transmitter center B (2104) to be connected to some mobile terminals such as a notebook type PC, PDA and mobile phone and the like through radio network. The image data taken from the external public network 2103 or the TV receiver set 2101 is distributed in a real time basis in response to a request from the mobile terminals. In addition, it may also be applicable that the image data taken from the external public network 2103 or the TV receiver set 2101 is once accumulated at the image memory device 2102 and the image data is properly distributed in response to the request from the mobile terminals. The distributing operation passing through the transmitter center a (2103)

is an example in which the mobile terminals such as the notebook type PC (2110), PDA (2109) and mobile phone 2108 or the like directly receive image data, see and hear them. In the case of distributing through the transmitter center B (2104), the image data passes through the relay center A (2105), the radio public network 2106 and the relay center B (2107) and the image data is received at the mobile terminals (2111, 2112, 2113). In addition, in the case of the distribution for outputting image data directly from the distribution server to the radio public network 2106, the image data passes through the relay center B (2107), and the image data is received at the mobile terminals (2111, 2112, 2113), seen and heard there. At each of the distributing paths, the image data may also be distributed through a plurality of transmitter centers, relay centers and radio line networks.

Fig. 22 shows an example of a typical applied form using the distribution server 200 and the receiving terminal 100 of the present invention.

Distributing of the image data is carried out such that the image data is transmitted from the distribution server 2201 in response to a request from the receiving terminal 100, the image data passes through the radio public network 2203 and the relay center 2202 and reaches the receiving terminal 100 acting as a requesting unit.

The aforesaid description up to now has been set such that the image bit rate switching operation responding to the request of the receiving terminal 100 is executed at the distribution server 2201. However, the image bit rate switching operation may also be carried out at the relay center 2202. With this operation, the relay center 2202 is satisfactorily required to perform the image bit rate switching control operation, resulting in that a processing load at the distribution side is reduced. Additionally, the receiving terminal 100 has an effect that its response is improved as the switching operation is carried out.

An example of charging form for the image distributing system to which the method of the present invention has been applied may be applied to the case in which a specified charge may be applied for every one image content distributing irrespective of presence or non-presence of the image bit rate switching operation. In addition, the charging may be applied in response to either the reproducing time (a distributing time) or an amount of distributed data irrespective of presence or non-presence of the image bit rate switching operation. Further, the charging added with the content of the image bit rate switching operation may be applied under any charging conditions such as the reproducing time (the distributing time) or the distributing data amount for every distribution

of one image content and the like. For example, when the image bit rate is low, the charging in utilization is calculated low and when the image bit rate is high, the charging in utilization is calculated low.

A specified charging for every image content distributing operation or a charging method associated with either the reproducing time or the distributing data amount or the like has some merits that the charging management can be easily performed at the distributing side and the utilization charge can be easily understood by a customer. In turn, quality of the distributed image or audio attained through application of the image bit rate switching control is apt to show a low quality when the image bit rate is low, and apt to show a high quality when the image bit rate is high. With this arrangement, the charging method having the content of the image bit rate switching operation adjusted has a merit in which a user can understand the utilization charge because an impression at the time of seeing or hearing reflects on the charging.

Fig. 23 shows one example of a user-interface of the receiving terminal 100.

This figure shows an example of GUI (Graphical User Interface) displayed at the monitor of the mobile terminal such as a PDA and the like. GUI is constituted by a moving image display frame 2309, a reproducing (an image

distributing start request) button 2301, a stop (an image distributing stop request) button 2302, a finish button 2303, an automatic and manual switching button 2304 for an image bit rate, manual selection buttons for the image bit rate (2305, 2306, 2307) and an operating state display frame 2308 or the like. It may also be applicable that the GUI may have, in addition to the foregoing elements, another operating button or display frame and the like as required. In the case that this system is actually installed in a mobile phone, these instruction buttons are arranged under an application of phone number input keys or menu keys or the like. The receiving terminal 2300 receives information such as image from the server through the antenna 2310 and displays it in sequence at the moving image display frame 2309. Applying of the present invention causes the bit rate of this moving image to be controlled. The image bit rate switching control may be carried out automatically by the receiving terminal 2300 and further manually switched by a user himself. For example, the image bit rate switching control is changed over through a toggle between an automatic mode and a manual mode every time the auto/manual switch button 2304 is depressed. In the case of manual mode, it may also be applicable that a user depresses the manual selection buttons (2305, 2306, 2307) corresponding to the type of the image bit rate to cause them to be switched. For

example, in the case of service in which the charging fee adjusted by the content of the image bit rate switching is applied to the utilization charge, the low image bit rate can be maintained continuously when it is desired to see or hear the image at a low charging fee. In addition, when an automatic switching control accompanied by a switching accuracy is being carried out, the automatic control is interrupted to enable the switching operation to be carried out under a user's preference against quality of the image even if the operation does not reach the automatic switching condition. In general, impression on seeing or hearing the moving image or audio sound shows a certain disturbance by individual users. A friendly user may act friendly against a slight variation in image quality and a sensitive user may be sensitive against variation in image quality. Due to this fact, it is possible to apply impression that a manual switching rather than an automatic switching of the image bit rate sometimes provides a more convenience in use.

Also in the case of image distribution under application of only a wired line such as an internet, variation in a data transfer speed is generated under an influence of an applied state of the line. However, in general, the wired line has frequently a far wider data transfer area as compared with that of the radio line and the variation of the receiving bit rate at the terminal

hardly produces a problem. In turn, it is practically difficult to assure a wide data transfer area with the radio line in view of the restrictions on the international standards or limitations on performance of the communication device or the like. Further, due to a characteristic of radio network, the device may easily be influenced by attenuation or reflection of the electromagnetic wave and surrounding environment and additionally a variation in the data transferring speed frequently happens. As described above, the method for image distributing operation of the present invention which has been described up to now is particularly effective in the case that it is applied to the image distributing system using the radio line where the variation in data transfer speed may easily occur.

It is also applicable that the distributed data handled by the image distribution apparatus of the present invention is a data of moving image only or a data of audio sound only. In addition, the data other than the moving image or audio sound may also be applied. These data may be data for Web (World Wide Web) such as still image data, text data, SGML (Standard Generalized Markup Language) or HTML (Hyper Text Markup Language).

As the monitoring means separate from the method for monitoring the receiving bit rate, it may also be applicable

that a residual amount of data at the memory unit 104 having the received data stored therein is monitored. The residual amount of data at the memory unit 104 is influenced by the data-receiving throughput. If the data receiving throughput is decreased, the residual amount of data is apt to be decreased. In turn, if the data-receiving throughput is increased, the residual amount of data is apt to be increased. In the case that these states are monitored and the residual amount of data is lower than the predetermined amount, it is switched to the image bit rate of lower level mode. In addition, when the residual amount of data exceeds the predetermined amount, it is switched to the image bit rate of upper level mode.

This method enables the monitoring operation to be executed on an extension of a data reading-out operation that the reproduction unit at the receiving terminal reads out and it can be installed while a processing amount of the monitoring operation is reduced.

In the case that the image data to be received is changed into a cipher code as another monitoring means and that the decoder 114 arranged in the reproducing unit 105 performs a decoding of the received data, it may also be applicable that a frame rate for the decoding operation is monitored. The frame rate of the decoding is influenced by the data-receiving throughput. The frame rate of decoding

is decreased because the frame to be reproduced does not reach as planned if the data-receiving throughput is decreased. In turn, if the data-receiving throughput is improved, the reproducing frame reaches the value more than a planned one, so that a frame rate of the decoding is improved. As a procedure for switching the receiving bit rate, the frame rate at the time of decoding, for example, is lower than the frame rate specified by the content, it is switched to the image bit rate of lower level mode. In addition, when it is lower than the frame rate specified by the content, it is switched to the image bit rate of upper level mode. According to this method, a complex calculation is not needed in particular, and the number of frames per a predetermined time is counted to enable the monitoring operation to be realized and so it is possible to mount it with a processing amount of monitoring operation being set low.

As a still further monitoring means, it may also be applicable that a time stamp included in the received image data is monitored. The reference timer 108 of the receiving terminal 100 manages the time stamp. For example, STC (System Time Clock) of the MPEG system corresponds to it. The image data of MPEG contains information concerning the reproduction time such as SCR (System Clock Reference), PTS (Presentation Time Stamp) and the like. SCR is meant

by a time becoming a reference of the reproducing time. At the receiving terminal 100, the reference time is set to STC, i.e. the reference timer 108 at the time of receiving SCR. PTS is a time information added for every frame of the image data and is used for controlling a timing reproducing the decoded frame. The decode image is displayed at the time of decoding a certain frame when the value of PTS of the frame is coincided with the value of STC. Also at the reproducing time management using PTS, it is influenced under the data-receiving throughput.

When the data-receiving throughput is decreased, PTS does not correspond to CTS because its decoding is also delayed, and a difference of time information is increased in a negative direction. In turn, if the data-receiving throughput is improved, the difference of time information is increased in a positive direction because a frame waiting for the reproduction is added. In the case that these relations are monitored and a difference between STC and PTS at the time of decoding operation exceeds a predetermined time difference in a negative direction, it is switched to the image bit rate of lower level mode. In addition, when the difference between STC and PTS exceeds more than a predetermined time difference in a positive direction, it is switched to an image bit rate of an upper level mode.

It is possible to get an accurate delay time when a data receiving operation is performed because this method checks a time information included in the image data. With this operation, it becomes possible to feed-back an accurate starting time against a reproduction starting operation after the image bit rate switching.

All the methods for monitoring the receiving bit rates described above execute a monitoring operation against monitoring trigger information sent from the distribution server for a predetermined period from a trigger information included in the monitoring trigger information sent from the distribution server.

According to the present invention, it becomes possible to provide an image distribution system using a radio line where a data transfer speed variation may easily occur, wherein the receiving terminal itself has a function to perform an accurate monitoring of receiving bit rate at the time of image streaming operation and a switching to the most-suitable image bit rate is requested to the server in response to the result of monitoring operation, resulting in that it becomes possible to provide means capable of executing a stable image streaming operation.